

Apprenticeship and Industry Training

Appliance Service Technician Apprenticeship Course Outline

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Apprenticeship

Apprenticeship is post-secondary education with a difference. Apprenticeship begins with finding an employer. Employers hire apprentices, pay their wages and provide on-the-job training and work experience. Approximately 80 per cent of an apprentice's time is spent on the job under the supervision of a certified journeyman or qualified tradesperson. The other 20 per cent involves technical training provided at, or through, a post-secondary institution – usually a college or technical institute.

To become certified journeymen, apprentices must learn theory and skills, and they must pass examinations. Requirements for certification—including the content and delivery of technical training—are developed and updated by the Alberta Apprenticeship and Industry Training Board on the recommendation of the Appliance Service Technician Provincial Apprenticeship Committee.

The graduate of the Appliance Service Technician apprenticeship program is a certified journeyman who will be able to:

- responsibly do all work tasks expected of a journeyman
- supervise, train and coach apprentices
- use and maintain hand and power tools to the standards of competency and safety required in the trade
- by skill and knowledge gained through training and experience repair, maintain and operate major and domestic appliances
- use with safety and competence the tools and test equipment required in repair and maintenance procedures
- read and understand work orders, prepare estimates, and interpret technical manuals
- write service reports, diagnose the cause of failures and keep service analysis records
- be thoroughly familiar with the safety requirements pertaining to appliances
- utilise the knowledge and may advance to service representatives or supervisory
- perform assigned tasks in accordance with quality and production standards required by industry

Apprenticeship and Industry Training System

Industry-Driven

Alberta's apprenticeship and industry training system is an industry-driven system that ensures a highly skilled, internationally competitive workforce in more than 50 designated trades and occupations. This workforce supports the economic progress of Alberta and its competitive role in the global market. Industry (employers and employees) establishes training and certification standards and provides direction to the system through an industry committee network and the Alberta Apprenticeship and Industry Training Board. The Alberta government provides the legislative framework and administrative support for the apprenticeship and industry training system.

Alberta Apprenticeship and Industry Training Board

The Alberta Apprenticeship and Industry Training Board provides a leadership role in developing Alberta's highly skilled and trained workforce. The board's primary responsibility is to establish the standards and requirements for training and certification in programs under the Apprenticeship and Industry Training Act. The board also provides advice to the Minister of Advanced Education and Technology on the needs of Alberta's labour market for skilled and trained workers, and the designation of trades and occupations.

The thirteen-member board consists of a chair, eight members representing trades and four members representing other industries. There are equal numbers of employer and employee representatives.

Industry Committee Network

Alberta's apprenticeship and industry training system relies on a network of industry committees, including local and provincial apprenticeship committees in the designated trades, and occupational committees in the designated occupations. The network also includes other committees such as provisional committees that are established before the designation of a new trade or occupation comes into effect. All trade committees are composed of equal numbers of employer and employee representatives. The industry committee network is the foundation of Alberta's apprenticeship and industry training system.

Local Apprenticeship Committees (LAC)

Wherever there is activity in a trade, the board can set up a local apprenticeship committee. The board appoints equal numbers of employee and employer representatives for terms of up to three years. The committee appoints a member as presiding officer. Local apprenticeship committees:

- monitor apprenticeship programs and the progress of apprentices in their trade, at the local level
- make recommendations to their trade's provincial apprenticeship committee (PAC) about apprenticeship and certification in their trade
- promote apprenticeship programs and training and the pursuit of careers in their trade
- make recommendations to the board about the appointment of members to their trade's PAC
- help settle certain kinds of disagreements between apprentices and their employers
- carry out functions assigned by their trade's PAC or the board

Provincial Apprenticeship Committees (PAC)

The board establishes a provincial apprenticeship committee for each trade. It appoints an equal number of employer and employee representatives, and, on the PAC's recommendation, a presiding officer - each for a maximum of two terms of up to three years. Most PACs have nine members but can have as many as twenty-one. Provincial apprenticeship committees:

- make recommendations to the board about:
 - standards and requirements for training and certification in their trade
 - courses and examinations in their trade
 - apprenticeship and certification
 - designation of trades and occupations
 - regulations and orders under the Apprenticeship and Industry Training Act
- monitor the activities of local apprenticeship committees in their trade
- determine whether training of various kinds is equivalent to training provided in an apprenticeship program in their trade
- promote apprenticeship programs and training and the pursuit of careers in their trade
- consult with other committees under the Apprenticeship and Industry Training Act about apprenticeship programs, training and certification and facilitate cooperation between different trades and occupations
- consult with organizations, associations and people who have an interest in their trade and with employers and employees in their trade
- may participate in resolving certain disagreements between employers and employees
- carry out functions assigned by the board

Appliance Service Technician PAC Members at the Time of Publication

Mr. H. Maloney	Edmonton.....	Presiding Officer
Mr. D. Carew	Edmonton.....	Employer
Mr. J. Griep	Edmonton.....	Employer
Mr. J. Lee	Calgary.....	Employee
Mr. K. Chun	Calgary.....	Employee
Mr. D. Rioux	Edmonton.....	Employee

Alberta Government

Alberta Advanced Education and Technology works with industry, employer and employee organizations and technical training providers to:

- facilitate industry's development and maintenance of training and certification standards
- provide registration and counselling services to apprentices and employers
- coordinate technical training in collaboration with training providers
- certify apprentices and others who meet industry standards

Technical Institutes and Colleges

The technical institutes and colleges are key participants in Alberta's apprenticeship and industry training system. They work with the board, industry committees and Alberta Advanced Education and Technology to enhance access and responsiveness to industry needs through the delivery of the technical training component of apprenticeship programs. They develop lesson plans from the course outlines established by industry and provide technical training to apprentices.

Apprenticeship Safety

Safe working procedures and conditions, incident/injury prevention, and the preservation of health are of primary importance in apprenticeship programs in Alberta. These responsibilities are shared and require the joint efforts of government, employers, employees, apprentices and the public. Therefore, it is imperative that all parties are aware of circumstances that may lead to injury or harm.

Safe learning experiences and healthy environments can be created by controlling the variables and behaviours that may contribute to or cause an incident or injury. By practicing a safe and healthy attitude, everyone can enjoy the benefit of an incident and injury free environment.

Alberta Apprenticeship and Industry Training Board Safety Policy

The Alberta Apprenticeship and Industry Training Board (board) fully supports safe learning and working environments and emphasizes the importance of safety awareness and education throughout apprenticeship training- in both on-the- job training and technical training. The board also recognizes that safety awareness and education begins on the first day of on-the-job training and thereby is the initial and ongoing responsibility of the employer and the apprentice as required under workplace health and safety training. However the board encourages that safe workplace behaviour is modeled not only during on-the-job training but also during all aspects of technical training, in particular, shop or lab instruction. Therefore the board recognizes that safety awareness and training in apprenticeship technical training reinforces, but does not replace, employer safety training that is required under workplace health and safety legislation.

The board has established a policy with respect to safety awareness and training:

The board promotes and supports safe workplaces, which embody a culture of safety for all apprentices, employers and employees. Employer required safety training is the responsibility of the employer and the apprentice, as required under legislation other than the *Apprenticeship and Industry Training Act*.

The board's complete document on its 'Apprenticeship Safety Training Policy' is available at www.tradesecrets.gov.ab.ca; access the website and conduct a search for 'safety training policy'.

Implementation of the policy includes three common safety learning outcomes and objectives for all trade course outlines. These common learning outcomes ensure that each course outline utilizes common language consistent with workplace health and safety terminology. Under the title of 'Standard Workplace Safety', this first section of each trade course outline enables the delivery of generic safety training; technical training providers will provide trade specific examples related to the content delivery of course outline safety training.

Addendum

As immediate implementation of the board's safety policy includes common safety learning outcomes and objectives for all course outlines, this trade's PAC will be inserting these safety outcomes into the main body of their course outline at a later date. In the meantime the addendum below immediately places the safety outcomes and their objectives into this course outline thereby enabling technical training providers to deliver the content of these safety outcomes.

STANDARD WORKPLACE SAFETY

A. Safety Legislation, Regulations & Industry Policy in the Trades

Outcome: *Describe legislation, regulations and practices intended to ensure a safe work place in this trade.*

1. Demonstrate the ability to apply the Occupational Health and Safety Act, Regulation and Code.
2. Explain the role of the employer and employee in regard to Occupational Health and Safety (OH&S) regulations, Worksite Hazardous Materials Information Systems (WHMIS), fire regulations, Workers Compensation Board regulations, and related advisory bodies and agencies.
3. Explain industry practices for hazard assessment and control procedures.
4. Describe the responsibilities of workers and employers to apply emergency procedures.
5. Describe positive tradesperson attitudes with respect to housekeeping, personal protective equipment and emergency procedures.
6. Describe the roles and responsibilities of employers and employees with respect to the selection and use of personal protective equipment (PPE).
7. Select, use and maintain appropriate PPE for worksite applications.

B. Climbing, Lifting, Rigging and Hoisting

Outcome: *Describe the use of personal protective equipment (PPE) and safe practices for climbing, lifting, rigging and hoisting in this trade.*

1. Select, use and maintain specialized PPE for climbing, lifting and load moving equipment.
2. Describe manual lifting procedures using correct body mechanics.
3. Describe rigging hardware and the safety factor associated with each item.
4. Select the correct equipment for rigging typical loads.
5. Describe hoisting and load moving procedures.

C. Hazardous Materials & Fire Protection.....

Outcome: *Describe the safety practices for hazardous materials and fire protection in this trade.*

1. Describe the roles, responsibilities features and practices related to the workplace hazardous materials information system (WHMIS) program.
2. Describe the three key elements of WHMIS.
3. Describe handling, storing and transporting procedures when dealing with hazardous material.
4. Describe safe venting procedures when working with hazardous materials.
5. Describe fire hazards, classes, procedures and equipment related to fire protection.

Workplace Health and Safety

A tradesperson is often exposed to more hazards than any other person in the work force and therefore should be familiar with and apply the Occupational Health and Safety Act, Regulations and Code when dealing with personal safety and the special safety rules that apply to all daily tasks.

Workplace Health and Safety (Alberta Employment, Immigration and Industry) conducts periodic inspections of workplaces to ensure that safety regulations for industry are being observed.

Additional information is available at www.worksafely.org

Technical Training

Apprenticeship technical training is delivered by the technical institutes and many colleges in the public post-secondary system throughout Alberta. The colleges and institutes are committed to delivering the technical training component of Alberta apprenticeship programs in a safe, efficient and effective manner. All training providers place great emphasis on safe technical practices that complement safe workplace practices and help to develop a skilled, safe workforce.

The following institutions deliver Appliance Service Technician apprenticeship technical training:

Southern Alberta Institute of Technology
(Main Campus)

Procedures for Recommending Revisions to the Course Outline

Advanced Education and Technology has prepared this course outline in partnership with the Appliance Service Technician Provincial Apprenticeship Committee.

This course outline was approved on January 2, 2007 by the Alberta Apprenticeship and Industry Training Board on a recommendation from the Provincial Apprenticeship Committee. The valuable input provided by representatives of industry and the institutions that provide the technical training is acknowledged.

Any concerned individual or group in the province of Alberta may make recommendations for change by writing to:

Appliance Service Technician Provincial Apprenticeship Committee

c/o Industry Programs and Standards

Apprenticeship and Industry Training

Advanced Education and Technology

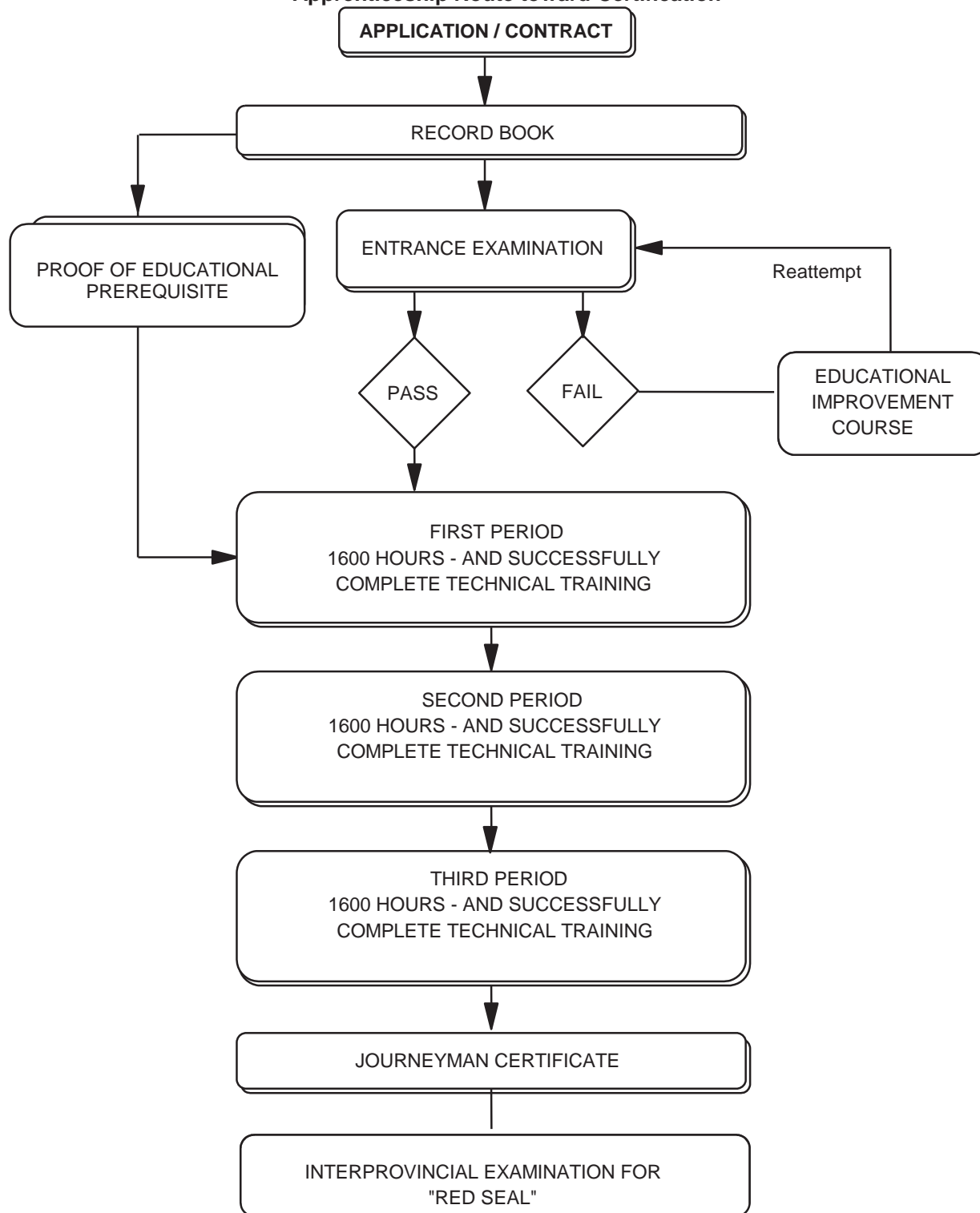
10th floor, Commerce Place

10155 102 Street NW

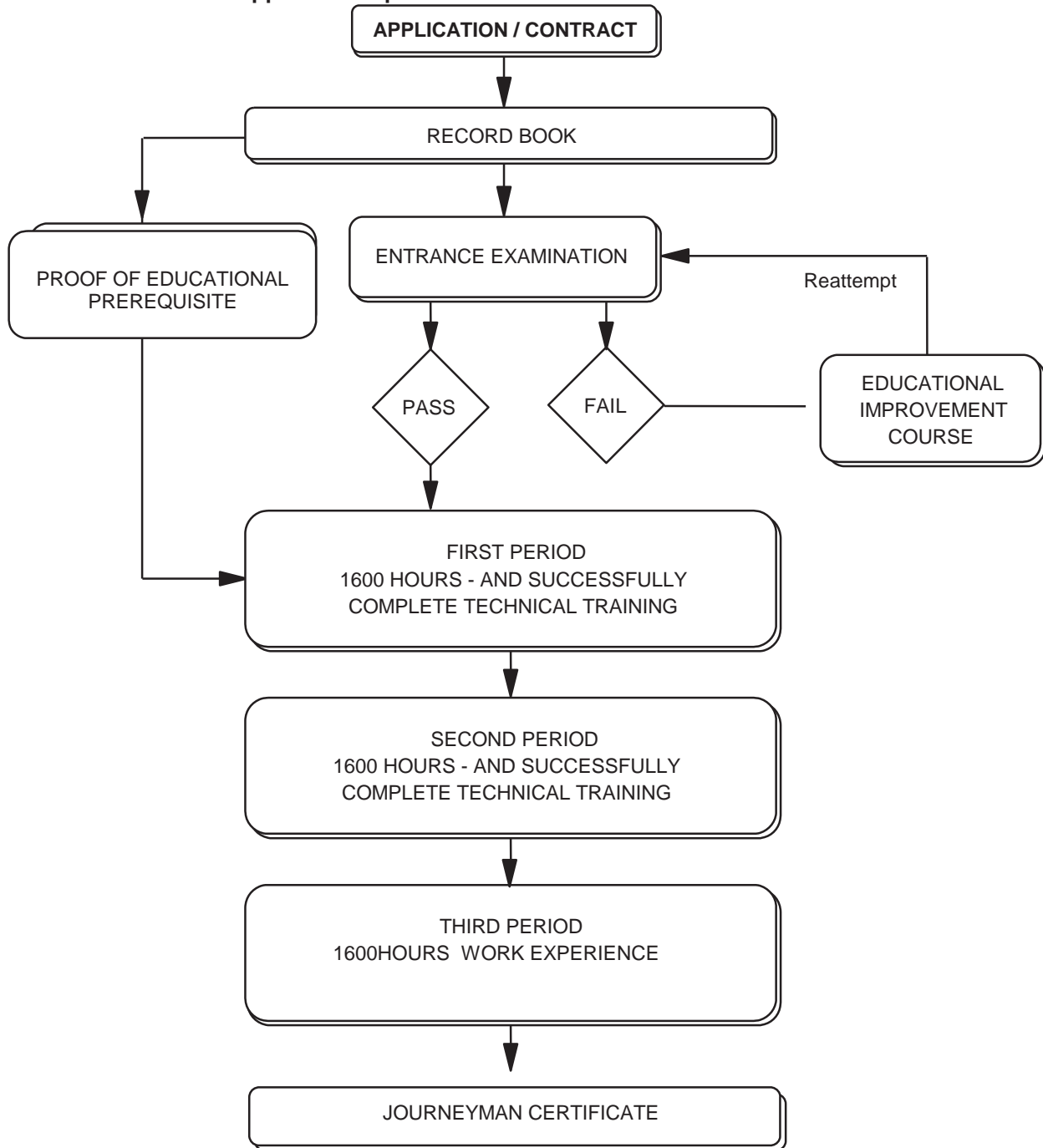
Edmonton AB T5J 4L5

It is requested that recommendations for change refer to specific areas and state references used. Recommendations for change will be placed on the agenda for regular meetings of the Appliance Service Technician Provincial Apprenticeship Committee.

Apprenticeship Route toward Certification

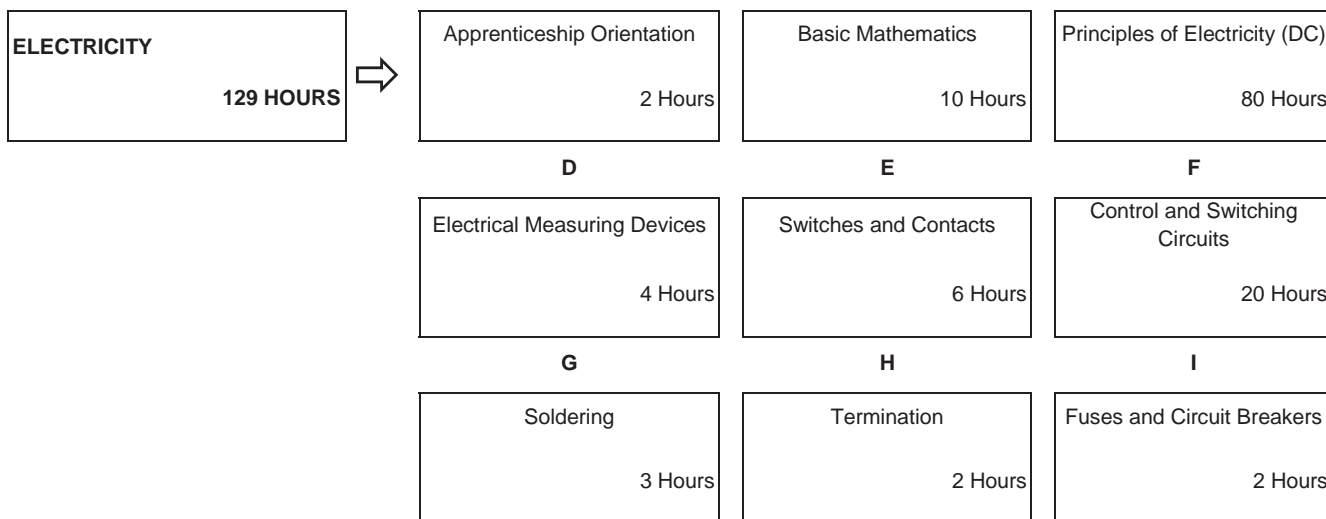


Apprenticeship Route toward Certification-Commercial

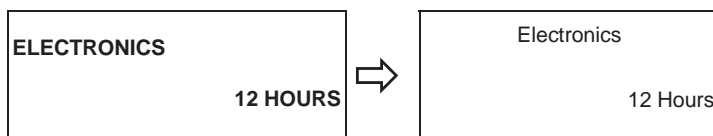


Appliance Service Technician Training Profile
(Common Training for Appliance Service Technician and Commercial Appliance Service Technician)
FIRST PERIOD
(8 Weeks 30 Hours per Week – Total of 240 Hours)

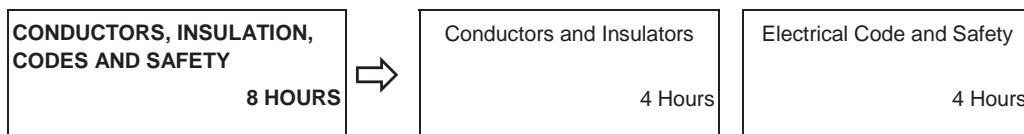
SECTION ONE



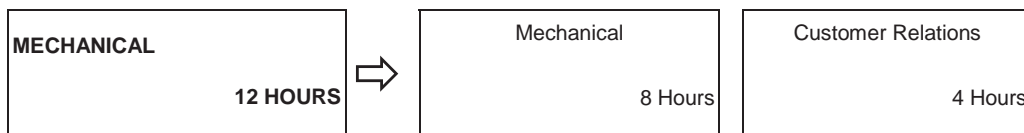
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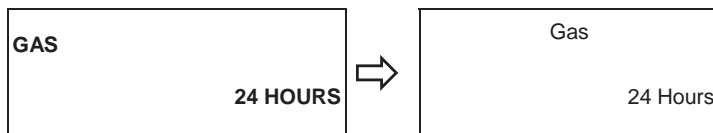
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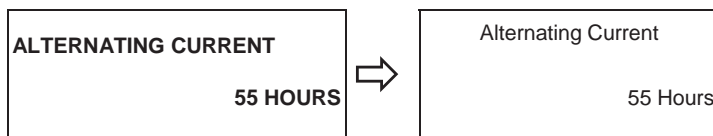
SECTION FOUR



SECTION FIVE



SECTION SIX



(Common Training for Appliance Service Technician and Commercial Appliance Service Technician)
SECOND PERIOD
(8 Weeks 30 Hours per Week – Total of 240 Hours)

SECTION ONE

ALTERNATING CURRENT
28 HOURS



A

Transformers
 10 Hours

B

Three-Phase Systems
 6 Hours

C

Motors
 12 Hours

SECTION TWO

**APPLIANCE OPERATING
 PRICIPLES**
60 HOURS



A

Operating Principles
 60 Hours

SECTION THREE

APPLIANCE COMPONENTS
60 HOURS



A

Components
 60 Hours

SECTION FOUR

**TROUBLESHOOTING
 (ELECTRICAL)**
92 HOURS



A

Electrical Testing
 50 Hours

B

Electronic Testing
 6 Hours

C

Appliance Controls
 36 Hours

(Appliance Service Technician Only)
THIRD PERIOD
(8 Weeks 30 Hours per Week – Total of 240 Hours)

SECTION ONE

OPERATING PRINCIPLES AND TROUBLESHOOTING
69 HOURS



A

Review of AC and DC Theory
12 Hours

B

Controls, Components and Operating Principles
57 Hours

SECTION TWO

BASIC REFRIGERATION
45 HOURS



A

Fundamental Physical Concepts
30 Hours

B

Refrigeration Cycle
15 Hours

SECTION THREE

APPLIANCE REFRIGERATION
62 HOURS



A

Refrigerants and Oils
8 Hours

B

Compressors
8 Hours

C

Evaporator Metering Devices
8 Hours

D

Evaporators and Condensers
4 Hours

E

Refrigerators and Freezers
6 Hours

F

System Dehydration
4 Hours

G

Domestic Air Conditioning
6 Hours

H

Leak Detection
4 Hours

I

Refrigeration Tools
4 Hours

J

Soldering and Brazing
10 Hours

SECTION FOUR

REFRIGERANT HANDLING
10 HOURS



A

Laws, Regulations and Codes
2 Hours

B

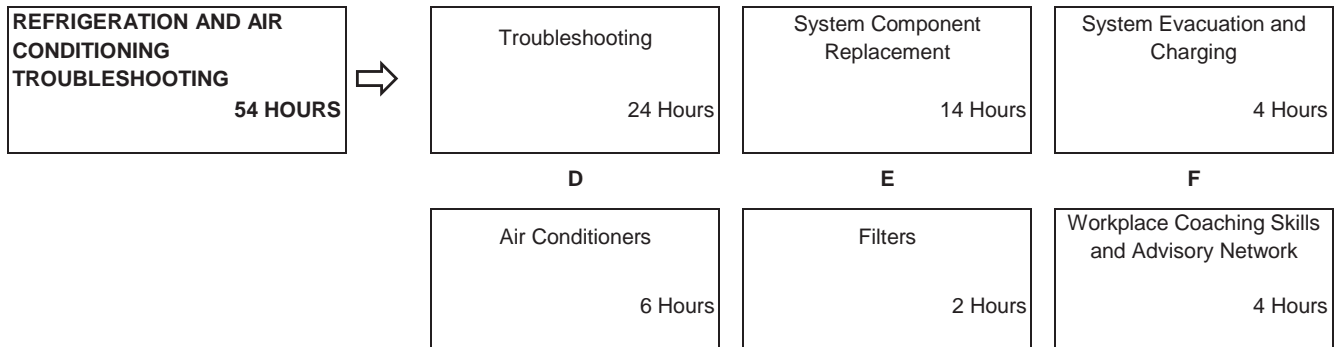
Refrigerants
2 Hours

C

Refrigeration Recovery, Recycling and Reclaiming
4 Hours

D

Refrigeration Management
2 Hours

SECTION FIVE

NOTE: The hours stated are for guidance and should be adhered to as closely as possible. However, adjustments must be made for rate of apprentice learning, statutory holidays, registration and examinations for the training establishment and Apprenticeship and Industry Training.

**FIRST PERIOD TECHNICAL TRAINING
APPLIANCE SERVICE TECHNICIAN TRADE
COURSE OUTLINE**

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

Due to the nature of the work of the Appliance Service Technician, it is imperative that safety be taught on a continuous basis throughout the entirety of this course.

Special emphasis should be placed on weak areas of theory and shop, which are evident from progressive tests and examinations administered throughout the course. The time required for such examinations and testing shall be allowed for in each area of instruction.

SECTION ONE:..... ELECTRICITY 129 HOURS

A. Apprenticeship Orientation.....2 Hours

Outcome: *Understand the role of the tradesperson, employers, Local Apprenticeship Committees, the Provincial Apprenticeship Committee and Alberta Apprenticeship and Industry Training in the development and maintenance of the Appliance Service Technician trade in Alberta.*

1. Describe the apprenticeship training system in Alberta.
2. Study the training profile of the Appliance Service Technician apprenticeship in Alberta.
3. Describe the Appliance Service Technician program outline learning outcomes and objectives.
4. Describe the responsibilities for the Contract of Apprenticeship by the apprentice, employer and Alberta Apprenticeship and Industry Training.
5. Describe a variety of employment opportunities for Appliance Service Technicians.
6. Become familiar with the contents of the apprenticeship training record book.

B. Basic Mathematics.....10 Hours

Outcome: *Solve trade-related problems using basic mathematical skills.*

1. Recognize basic arithmetic symbols.
2. Add whole, decimal and fractional numbers.
3. Subtract whole, decimal and fractional numbers.
4. Multiply whole, decimal and fractional numbers.
5. Divide whole, decimal and fractional numbers.
6. State the correct sequence for arithmetical operations and solve equations which use brackets.

C. Principles of Electricity (DC).....80 Hours

Outcome: *Understand the basic principles of electricity, units of measure and their application.*

1. Explain the fundamental relationship between the structure of the atom and the flow of electrons.
2. Describe the relationship of voltage, current and resistance in an electric circuit.
3. Solve problems using Ohm's law.
4. Connect circuits and make voltage, current and resistance measurements to verify Ohm's law.
5. Define quantity, express symbols and units of measurement for the following electrical terms:
 - a) volts
 - b) amperes
 - c) ohms
 - d) watts
 - e) watt-hours
 - f) coulombs
6. Apply Kirchhoff's current and voltage laws to circuits.
7. Analyse and solve problems involving series, parallel and Edison three wire circuits and identify their applications (balanced and unbalanced).
8. Describe the effect that an open or high resistance neutral connection will have on electrical equipment (balanced and unbalanced).
9. Define and distinguish between line loss and voltage drop as it applies to electrical power systems.
10. Define and state the units of power and energy.
11. Calculate electrical power, voltage resistance and current relationships.
12. Calculate electrical energy and cost.
13. Describe electromagnetism and its uses.

D. Electrical Measuring Devices4 Hours

Outcome: *Describe proper use, care and safety precautions for various electrical meters.*

1. Describe the use, care and safety precautions for:
 - a) ammeters
 - b) voltmeters
 - c) ohmmeters
 - d) wattmeters
 - e) multimeters
2. Demonstrate mode and range selection and connections of a multimeter.
3. Describe what is meant by sensitivity.
4. Demonstrate accurate measurements.
5. Use electrical instruments to confirm electrical failure.

E. Switches and Contacts.....6 Hours**Outcome:** *Understand, identify and test various switches and contacts.*

1. Recognize and explain the use of the following devices and their symbols:
 - a) momentary contact
 - b) maintained contact
 - c) float switches
 - d) pressure switches
 - e) limit switches
2. Describe the difference in construction and operation between magnetic and thermal relays.
3. Describe the purpose and operation of thermally operated contacts, overloads and thermostats.
4. Determine condition of contacts by visual means and resistance test.

F. Control and Switching Circuits20 Hours**Outcome:** *Basic understanding of wiring diagrams and schematics, and their use as diagnostic tools.*

1. Recognize standard symbols used in schematic and/or wiring diagrams.
2. Demonstrate the ability to develop schematic diagrams and connect equipment to operate as directed.
3. Transpose a schematic diagram to a wiring diagram and transpose a wiring diagram into a schematic diagram.
4. Explain the sequence of electrical operation with the aid of bar charts.
5. Use diagrams to troubleshoot and locate electrical failure.

G. Soldering.....3 Hours**Outcome:** *Demonstrate the basic techniques for soldering and de-soldering electrical components.*

1. List the characteristics of various solders and fluxes, and their uses.
2. Describe the health hazard of using lead based solder.

H. Termination.....2 Hours**Outcome:** *Understand and demonstrate electrical connections and terminations.*

1. Describe the importance of electrically and mechanically sound connections.
2. Describe the procedure when splicing dissimilar metals.
3. Describe various types of terminals and their applications.
4. Demonstrate methods of making connections.

I. Fuses and Circuit Breakers2 Hours**Outcome:** *Describe the purpose and application of fuses and circuit breakers.*

1. Define the terms:
 - a) overcurrent
 - b) overload
 - c) short circuit

2. Describe and give the purpose of the types of fuses and circuit breakers.
3. Describe how the ambient temperature affects fusing.

SECTION TWO: ELECTRONICS 12 HOURS

A. Electronics 12 Hours

Outcome: *Understand and diagnose electronic components and circuit boards.*

1. Identify schematic symbols of the following:
 - a) diode
 - b) transistor (PNP and NPN)
 - c) SCR
 - d) triac
 - e) zener diode
 - f) varistor
 - g) thermistor
2. Describe the purpose and application of:
 - a) SCR's
 - b) triacs
 - c) diodes
 - d) transistors
 - e) varistors
 - f) thermistors
 - g) zener diodes
3. Test electronic boards and devices as per wiring diagrams.
4. Describe some problems of static electricity when handling/cleaning electronic circuit boards and connections.
5. Diagnose triacs, diodes, varistors and thermistors.
6. Program microprocessors as per manufacturer's specs.

SECTION THREE: CONDUCTORS, INSULATION, CODES AND SAFETY 8 HOURS

A. Conductors and Insulators 4 Hours

Outcome: *Describe the characteristics and application of conductors and insulators.*

1. Describe the characteristics and application of the following conductor materials:
 - a) silver
 - b) copper
 - c) gold
 - d) aluminum
 - e) nichrome
2. Interpret an A.W.G. Table.
3. List wire sizes used to supply appliances and quote the fuse rating of each.
4. Describe the relationship between resistance, length, cross sectional area and type of material of a conductor.

5. Define the following conductor terminology:
 - a) hot
 - b) grounded
 - c) neutral
 - d) identified
 - e) ground
 - f) neoprene
 - g) plastics
6. Specify which circuit conductors must have white or green insulation.
7. Define the term dielectric strength.

B. Electrical Code and Safety.....4 Hours

Outcome: *Understand electrical codes, electrical hazards, safe working techniques and procedures when working with electrical circuits and rotating equipment.*

1. Describe the object and scope of the rules of the Canadian Electrical Code as it applies to:
 - a) grounding of equipment
 - b) soldering fluxes
 - c) C.S.A. and other approval bodies and consequences of altering
 - d) limits of the Appliance Service Technician
2. Identify electrical hazards, safe working techniques and procedures when working with electrical circuits and rotating equipment.
3. Dressing and routing of wires and wire harnesses to appliance structure.

SECTION FOUR:MECHANICAL..... 12 HOURS

A. Mechanical.....8 Hours

Outcome: *Understand the safe use of common hand, power, and specialty tools and equipment.*

1. Identify and describe the safe use of common hand tools and equipment.
2. Identify and describe the safe use of common power and specialty tools.
3. Recognize metric and imperial threads.
4. Recognize various fastening devices, including:
 - a) threaded
 - b) spring clips
 - c) rivets
5. Demonstrate the installation and maintenance of various types of bearings.
6. Describe and demonstrate the application of various types of seals, gaskets and boots.
7. Recognize the condition of drive belts, pulleys and couplings and demonstrate their replacement.
8. Describe various lubricants and their application.
9. Describe gear reduction.

B. Customer Relations4 Hours**Outcome: Understand the aspects of customer relations.**

1. Communicate effectively with customers and co-workers.
2. Demonstrate proper appearance.
3. Portray a positive image.
4. Courteous driving habits.

SECTION FIVE: GAS24 HOURS**A. Gas24 Hours****Outcome: Understand the principles and characteristics of gas fired appliances.**

1. Describe the characteristics and uses of natural and propane gases.
2. Describe safety precautions in dealing with gases.
3. Adjust gas and air mixture to pilot and main burner.
4. Test thermocouple for output.
5. Test electronic ignition systems.
6. List the fittings used for connecting gas appliances according to the gas code.
7. Review the gas code installation requirements for ranges, ovens, dryers and barbecues.
8. Troubleshoot gas system.
9. Test thermopile for output.
10. Describe the characteristics in ranges, ovens, dryers and barbecues, with reference to:
 - a) the properties of natural and propane (LP) gas
 - b) igniters
 - c) burners
 - d) valves
 - e) flame provers
 - f) pilot flame
 - g) electronic ignition systems
 - h) regulators
 - i) air proving switches

SECTION SIX:ALTERNATING CURRENT55 HOURS**A. Alternating Current55 Hours****Outcome: Understand the principles of alternating current.**

1. Describe the sine wave.
2. Explain and calculate average, effective and peak values.
3. Define:
 - a) vector
 - b) phase
 - c) lead
 - d) lag
 - e) cycle

- f) angles in electrical degrees
- 4. Define and state units of measurement.
- 5. State factors affecting resistance.
- 6. State phase relationships between voltage and current.
- 7. Define inductance and state its symbol and unit of measurement.
- 8. List the factors that affect inductance.
- 9. Define and state the unit of measurement for inductive reactance and its symbol.
- 10. State the phase relationship between voltage and current in an inductive circuit.
- 11. Describe capacitance and the factors that affect it.
- 12. Describe the construction and characteristics of an elementary capacitor.
- 13. Describe testing for open and shorts.
- 14. Describe capacitor types and applications.
- 15. State the unit of measurement for the charge of a capacitor and give its symbol.
- 16. Give the symbol for capacitive reactance and state its unit of measurement.
- 17. State the phase relationship between voltage and current in a capacitive circuit.
- 18. State connection methods for capacitors in series and parallel.
- 19. Define impedance and list its symbols.
- 20. State the units of measurement for impedance.
- 21. Restate formulas required to calculate impedance.
- 22. State the factors that affect impedance.
- 23. Use the "impedance triangle" to solve electrical problems.

**SECOND PERIOD TECHNICAL TRAINING
APPLIANCE SERVICE TECHNICIAN TRADE
COURSE OUTLINE**

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Due to the nature of the work of the Appliance Service Technician, it is imperative that safety be taught on a continuous basis throughout the entirety of this course.

Special emphasis should be placed on weak areas of theory and shop, which are evident from progressive tests and examinations administered throughout the course. The time required for such examinations and testing shall be allowed for in each area of instruction.

SECTION ONE:.....ALTERNATING CURRENT 28 HOURS

A. Transformers..... 10 Hours

Outcome: ***Describe how and why transformers are used in different applications.***

1. Describe the basic components and the purposes of a transformer.
2. Define the primary and secondary windings of a transformer.
3. Differentiate between a step-up and a step-down transformer.
4. State the standard terminal and winding identification.
5. State how transformers are rated and sized.
6. Describe and solve problems involving transformer voltage, turns and current ratios.
7. Describe troubleshooting techniques and procedures to confirm transformer failures.

B. Three-Phase Systems (General) 6 Hours

Outcome: ***Describe a three-phase electrical system and explain how it is different from a single-phase system.***

1. Explain the difference between single-phase power and three-phase power.
2. Explain the generation of the phase voltages of a three-phase system.
3. Explain the phase sequence of three-phase sine waves.
4. State three main advantages of three-phase power over single-phase power.

C. Motors..... 12 Hours

Outcome: ***Describe how motors are used in different applications.***

1. Describe the different characteristics of single phase motors including:
 - a) series (universal)
 - b) split phase (open and sealed)
 - c) capacitor
 - i) capacitor start
 - ii) permanent split capacitor
 - iii) two value capacitor
 - d) shaded pole
 - e) synchronous

2. Describe the installation of solid state, current and potential relays and centrifugal starting switches.
3. Describe motor overload protection.
4. Describe basic three phase motor theory.
5. Describe and demonstrate troubleshooting techniques.
6. Describe the relationship between poles and rotational frequency.

SECTION TWO: APPLIANCE OPERATING PRINCIPLES..... 60 HOURS

A. Operating Principles60 Hours

Outcome: *Demonstrate operating principles of appliances using schematics and bar charts.*

1. Describe, in sequential form, the operating principles of the following appliances:
 - a) dishwasher
 - b) microwave oven
 - c) range (gas and electric)
2. Interpret manufacturer's specifications, manuals and drawings for each appliance.
3. Redraw electric circuit diagrams in different forms (i.e. ladder type).
4. Demonstrate the use of bar charts and schematic diagrams as an aid in describing circuit operation.

SECTION THREE: APPLIANCE COMPONENTS..... 60 HOURS

A. Components.....60 Hours

Outcome: *Understand the principles and operation of various appliance components.*

1. Describe the operation principles and applications of these safety features (gas and electric):
 - a) door interlocks
 - b) hi-limit switches
 - c) motor overloads
 - d) fuses and circuit breakers
 - e) ground connections
 - f) heating elements
2. Describe the operation of devices for:
 - a) filling
 - b) measuring
 - c) mixing
 - d) moving
 - e) draining of water
 - f) overflow switches
 - g) chemical injection
3. Describe the characteristics and uses of:
 - a) detergent
 - b) citric acid
 - c) rinse agent
 - d) bleach
 - e) anti-static material

- f) soap
- 4. Describe the characteristics, symbol and application of the following:
 - a) sequential switches
 - b) magnetic relay
 - c) thermal relay
 - d) reversing switch
 - e) solid state switches
- 5. Describe the characteristics of ranges:
 - a) self-cleaning ovens
 - b) convection ovens
 - c) smoke eliminator
 - d) rotisserie
 - e) controls (manual and electronic)
 - f) heating element
- 6. Determine the condition of the hi-voltage components in a microwave oven including:
 - a) magnetron tube
 - b) transformer
 - c) capacitor
 - d) diode
 - e) door interlock switches
 - f) fuses and circuit breakers
 - g) inverter
- 7. Verify proper appliance installation including:
 - a) flooring
 - b) venting and make-up air
 - c) clearances
 - d) drainage
 - e) water, power and gas supply

SECTION FOUR:TROUBLESHOOTING (ELECTRICAL) 92 HOURS

A. Electrical Testing50 Hours

Outcome: ***Demonstrate the ability to identify, test and troubleshoot electrical components.***

- 1. Review the use and adjustment of electrical testing meters including:
 - a) clamp-on ammeters
 - b) voltmeters
 - c) ohmmeters
 - d) multimeters
 - e) meggers
- 2. Identify faulty components.
- 3. Tests troubleshoot and calibrate controls.
- 4. Demonstrate the procedures for testing motors.
- 5. Demonstrate the procedures for testing other electrical components and circuits.
- 6. Select proper replacement electrical parts.

B. Electronic Testing.....6 Hours

Outcome: *Demonstrate the ability to identify, test and troubleshoot electronic components.*

1. Demonstrate the procedures for testing electronic components.
2. Select proper replacement electronic parts.

C. Appliance Controls.....36 Hours

Outcome: *Demonstrate use of diagnostic instruments and techniques.*

1. Demonstrate the use of bar charts and schematic diagrams as an aid in troubleshooting faults.
2. Demonstrate the use of suitable instruments to check for:
 - a) electrical resistance
 - b) voltage
 - c) current
 - d) power
 - e) temperature
 - f) microwave leakage
3. Demonstrate a technique for systematic troubleshooting of appliances.

**THIRD PERIOD TECHNICAL TRAINING
APPLIANCE SERVICE TECHNICIAN TRADE
COURSE OUTLINE**

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

Due to the nature of the work of the Appliance Service Technician, it is imperative that safety be taught on a continuous basis throughout the entirety of this course.

Special emphasis should be placed on weak areas of theory and shop which are evident from progressive tests and examinations administered throughout the course. The time required for such examinations and testing shall be allowed for in each area of instruction.

SECTION ONE:..... OPERATING PRINCIPLES AND TROUBLESHOOTING 69 HOURS

A. Review of AC and DC Theory 12 Hours

Outcome: *Understand AC and DC fundamentals.*

1. Demonstrate electronic control diagnostic techniques.
2. Demonstrate AC and DC applications.

B. Controls, Components and Operating Principles57 Hours

Outcome: *Demonstrate the ability to troubleshoot appliances.*

1. Describe, in sequential form, the operating principles of the following appliances:
 - a) clothes dryer (gas, electric and condensing)
 - b) clothes washer
 - c) waste compactor
 - d) waste disposer
2. Demonstrate the ability to interpret fault codes.
3. Interpret manufacturer's specifications, manuals and drawings.
4. Redraw electric circuit diagrams in different forms (i.e. ladder type).
5. Demonstrate the use of bar charts and schematic diagrams as an aid in describing circuit operation.
6. Describe the characteristics and uses of:
 - a) clutch assemblies
 - b) transmissions
 - c) damping and snubbing systems
 - d) pumps
 - e) suspension and shock systems

SECTION TWO:..... BASIC REFRIGERATION..... 45 HOURS

A. Fundamental Physical Concepts30 Hours

Outcome: *Understand the basic concepts of refrigeration.*

1. Define energy.
2. Describe the two basic laws of thermodynamics.
3. Define heat in terms of energy.
4. Describe how heat is generated.
5. Describe heat transfer in solids, liquids, vapours and vacuums.
6. Define conduction, convection, radiation and sublimation.
7. Define sensible heat.
8. Determine total sensible heat gain in specific substances.
9. Define latent heat.
10. Determine total latent heat gain.
11. Describe the changes that occur when a substance changes from a solid to liquid then to a vapour and the reverse process.
12. Define saturation.
13. Define sublimation.
14. Define superheating.
15. Define subcooling.
16. Define British thermal unit (Btu).
17. Define kilojoule (kJ).
18. Solve total heat calculations using Btu's and kJs.
19. Define temperature.
20. Describe temperature scales in both Fahrenheit and Celsius.
21. Determine Celsius from Fahrenheit and vice versa.
22. Describe and effectively use temperature measuring devices.
23. Define pressure.
24. Describe pressure scales in both pounds per square inch (psi) and kilopascals (kPa).
25. Determine kPa from psi and vice versa.
26. Describe and effectively use pressure measuring devices.
27. Define the gas laws of Dalton, Charles and Boyle.
28. Solve problems using the general gas law.
29. Define refrigerant.

B. Refrigeration Cycle.....15 Hours

Outcome: *Describe the basic refrigeration system.*

1. Identify and describe the essential components of the basic system.
2. Describe the conditions of the refrigerant as it flows through the cycle.

3. Identify and describe:
 - a) the absorption cycle
 - b) the evaporative process
 - c) the thermal electric process
 - d) other processes

SECTION THREE: APPLIANCE REFRIGERATION..... 62 HOURS

A. Refrigerants and Oils8 Hours

Outcome: *Describe the properties and characteristics of refrigerants and oils.*

1. Describe requirements for the disposal and reclaiming of refrigerants.
2. List the desirable qualities of a good refrigerant.
3. List hazards associated with the refrigerant used in domestic refrigerating and air conditioning.
4. Describe each refrigerant including its chemical name and formula and cylinder colour code.
5. List the properties of each that make them desirable for domestic use.
6. List the hazards of these refrigerants for both the user and the service person.
7. Describe the products of combustion of these refrigerants.
8. Define viscosity, pour point, miscibility, wax content and flash point.
9. Describe how oil is added to or removed from a refrigeration system.
10. Interpret environmental protection standards (Code of Practice).

B. Compressors.....8 Hours

Outcome: *Describe the operating principles of various compressors.*

1. Describe hermetic compressors.
2. Briefly describe how open and semi-hermetic compressors differ from hermetic compressors.
3. Describe the construction and operation of reciprocating compressors.
4. Describe the construction and operation of rotary compressors.
5. Briefly describe the construction and operation of a scroll compressor.
6. Describe the operation of variable speed compressors.
7. Describe the construction of the compressor shell.
8. Identify and explain the purpose of:
 - a) crankshafts
 - b) pistons
 - c) connecting rods
 - d) valves
 - e) oil cooler loops
 - f) mounting springs
9. Describe hermetic compressor lubrication methods.
10. Differentiate between a compressor's theoretical displacement and actual displacement.
11. Describe the cooling methods employed for domestic compressor motors and compressors.

C. Evaporator Metering Devices8 Hours**Outcome:** *Describe applications and principles of capillary tubes.*

1. List applications of capillary tubes.
2. Describe construction and operating principles.
3. Describe how to determine evaporator and system superheat.
4. Describe correct methods of replacing a heat exchanger in the system.
5. List symptoms of:
 - a) overcharge
 - b) undercharge
 - c) restricted capillary tube
6. Describe the cleaning methods for a restricted capillary tube.

D. Evaporators and Condensers4 Hours**Outcome:** *Explain the purpose, operation and test procedures of evaporators and condensers.*

1. List purpose, operation and test procedures.

E. Refrigerators and Freezers6 Hours**Outcome:** *Describe operating principles, construction, installation and troubleshooting of refrigerators, freezers and ice makers.*

1. Describe the general refrigerator construction and operation of refrigerators for:
 - a) manual defrost
 - b) cycle defrost
 - c) frost free
 - d) computer controlled
 - e) adaptive defrost
2. Describe the general construction and operation of:
 - a) chest freezers
 - b) upright freezers
3. Briefly describe icemakers and their operation.
4. List the principles of operation of a variety of freezer mounted icemakers.
5. List the principles of operation of a variety of stand alone icemakers.
6. Describe the general installation procedures for icemakers.
7. Describe procedures for troubleshooting and cleaning icemakers.
8. List the procedures for removing and replacing doors.
9. Remove and replace a door liner.
10. Remove and replace a door gasket.
11. Properly adjust doors.
12. List reasons for proper levelling of fridges and freezers.
13. Properly level a refrigerator and a chest freezer.

F. System Dehydration 4 Hours**Outcome:** *Understand the principles of system dehydration.*

1. Describe the evacuation process.
2. List the types of vacuum pumps.
3. Describe three methods of system evacuation.
4. Describe drier construction.
5. List the purposes of driers.
6. List the consequences of improper evacuation and dehydration.

G. Domestic Air Conditioning 6 Hours**Outcome:** *Understand the principles of domestic air conditioning.*

1. Define each of the following properties of air:
 - a) heat content
 - b) moisture content
 - c) humidity
2. Describe each of the following processes for conditioning the air:
 - a) air heating
 - b) air cooling
 - c) humidifying
 - d) dehumidifying
 - e) air cleaning
3. Describe the methods of sizing and selecting domestic air conditioners.
4. List the procedures for installing air conditioners.
5. List the servicing requirements of air conditioners.

H. Leak Detection 4 Hours**Outcome:** *Describe various methods of leak detection.*

1. Describe and demonstrate the use of solutions which are used in the bubble method to indicate gas leaks.
2. Describe and demonstrate the proper use and adjustment of electronic leak detectors to indicate gas leaks.
3. Describe and demonstrate the use of dyes for leak detection.

I. Refrigeration Tools..... 4 Hours**Outcome:** *Demonstrate correct use of refrigeration tools.*

1. Correctly select and use refrigeration tools for:
 - a) bending
 - b) cutting
 - c) swaging
2. Maintain and store refrigeration tools in a safe working condition.

3. Correctly assemble several lengths of copper tube for use in leak detection; use the various methods mentioned above including:
 - a) bending
 - b) swaging
 - c) pinching off

J. Soldering and Brazing 10 Hours

Outcome: *Describe and demonstrate soldering and brazing techniques.*

1. Describe the characteristics and safety requirements of acetylene, propane and butane.
2. Identify the equipment used for refrigeration soldering and brazing in terms of:
 - a) cylinder colours
 - b) thread design
 - c) connection types and sizes
3. Describe the construction and operation of gas regulators.
4. Describe the care and handling of hoses.
5. Describe the methods and precautions of detecting leaks in flammable gas equipment.
6. List and identify the parts of:
 - a) prestolite type torches
 - b) turbo type torches
7. Select and properly use a variety of torch sizes.
8. Describe and demonstrate the correct lighting and extinguishing procedures.
9. Properly prepare metal to be joined, including:
 - a) cleaning
 - b) fluxing
10. Describe, grade and use the following solder and brazing materials:
 - a) 50/50 solder
 - b) 95/5 solder
 - c) resin core solder
 - d) silfos
 - e) hard silver solder
 - f) soft silver solder
11. Demonstrate the proper use of the above solders while:
 - a) cleaning joints
 - b) fluxing joints
 - c) soldering
 - d) brazing
 - e) clean-up
12. Successfully join by soldering, brazing pieces of copper tube in several variations of the following sizes:
 - a) 1/4"
 - b) 5/16"
 - c) 3/8"
 - d) 1/2"

13. Demonstrate the proper use, care and maintenance of oxyacetylene brazing equipment, including:
 - a) setting up and balancing of a torch
 - b) preventing of backfire and flashbacks
 - c) choosing of a rod and flux
 - d) safety precautions in dealing with gases
14. Describe the safety precautions and protection of components and work area when brazing and soldering.

SECTION FOUR: REFRIGERANT HANDLING 10 HOURS

A. Laws, Regulations and Code..... 2 Hours

Outcome: *Understand regulations applying to refrigerant handling.*

1. Describe the Government of Canada's regulations affecting refrigeration and the environment.
2. Describe the sections in Environment Canada's latest code for refrigerant practice that apply to, or provide recommendations for the following:
 - a) refrigerant management definitions
 - b) chlorofluorocarbons and the Earth's ozone layer
 - c) methods of minimizing emissions
 - d) leak detection
 - e) piping and tubing installation and repair
 - f) use and maintenance of gauges and hoses
 - g) evacuation
 - h) adding and removing refrigerants
 - i) refrigerant recovering, reusing, recycling, reclaiming and disposing
 - j) equipment disposal
 - k) training personnel and informing customers
3. Describe How Alberta's Environmental Act impacts the servicing of sealed refrigeration systems.
4. Describe Alberta's Environment's Ozone Depletion Regulation and the results of non compliance.
5. Describe the B-52 Mechanical Refrigeration Code.
6. Describe the code sections that apply to servicing sealed systems.
7. List the governments, agencies and organisations producing guidelines or responsible for:
 - a) refrigerant manufacturing
 - b) refrigerant importation
 - c) refrigerant numbering and coding
 - d) ranking refrigerants for safety
 - e) buying and selling refrigerants for service
 - f) determine refrigerant usage
 - g) refrigerant storage
 - h) refrigerant transportation
 - i) refrigerant disposal
8. List the refrigerant management responsibilities of:
 - a) service contractors and companies
 - b) technicians
 - c) consumers

B. Refrigerants.....2 Hours

Outcome: *Describe different refrigerants and their application.*

1. Describe the chemical composition of hydrofluorocarbons.
2. Describe the operating characteristics of R-134a.
3. Explain why R-134a is being used in new refrigeration systems where R-12 was used.
4. Describe the concerns of R-134a with respect to human safety, equipment efficiency and the environment.
5. Describe the chemical composition of chlorofluorocarbons.
6. Compare the chemical composition of R-12 and R-134a.
7. Compare the operating characteristics of R-12 to R-134a.
8. Describe how chlorine affects the ozone layer in the upper atmosphere.
9. Describe the chemical composition of R-22.
10. Explain why R-22 is not being phased out as quickly as R-12.
11. Describe blended refrigerants that may be used in small sealed refrigeration systems.
12. Describe the replacement of R-12 with a temporary replacement refrigerant.

C. Refrigerant Recovery, Recycling and Reclaiming4 Hours

Outcome: *Describe and demonstrate procedures for refrigerant recovery, recycling and reclaiming.*

1. Demonstrate the proper use and care of portable refrigerant recovery equipment.
2. Recover refrigerants using various methods.
3. Solve and correct recovery equipment failure.
4. Describe the required components of refrigerant recycling equipment.
5. Describe the use and care of refrigerant recycling equipment.
6. Recycle recovered refrigerant.
7. Describe the procedures when recycling equipment fails during processing.
8. Describe the procedures for recovering and processing refrigerant oil.
9. Describe the procedures for recovering and processing various contaminants from refrigeration systems.
10. Describe the warranty concerns of appliance manufacturers.
11. Describe the process to return refrigerants to virgin status.
12. List the specifications for reclaimed refrigerants:
 - a) ARI standards
 - b) ASHRAE standards

D. Refrigerant Management2 Hours

Outcome: *Describe and demonstrate refrigerant handling techniques.*

1. Demonstrate effective and safe storage techniques.
2. Label and manage cylinders containing recycled refrigerants.
3. Describe the requirements for safe, effective and legal refrigerant transport.

4. Demonstrate storage cylinder to charging cylinder refrigerant transfer.
5. Demonstrate charging cylinder to refrigeration system refrigerant transfer.

SECTION FIVE:REFRIGERATION AND AIR CONDITIONING TROUBLESHOOTING..... 54 HOURS

A. Troubleshooting24 Hours

Outcome: *Demonstrate the ability to diagnose a sealed system.*

1. Describe and demonstrate the proper use of refrigeration gauges, manifolds and hoses.
2. List and describe the various methods for accessing a sealed refrigeration system.
3. List the suspected problems for the following abnormal system (standard refrigeration) conditions:
 - a) condenser pressure high, evaporator pressure high
 - b) condenser pressure high, evaporator pressure low
 - c) condenser pressure low, evaporator pressure high
 - d) condenser pressure low, evaporator pressure low
 - e) condenser pressure normal, evaporator pressure low
 - f) condenser pressure normal, evaporator pressure high
 - g) condenser pressure low, evaporator pressure normal
 - h) condenser pressure high, evaporator pressure normal
4. Demonstrate the troubleshooting of compressors with problems of a non-electrical nature.
5. Troubleshoot other system components.
6. Diagnose variable speed systems.

B. System Component Replacement 14 Hours

Outcome: *Demonstrate the ability to repair and replace sealed system components.*

1. Properly remove and seal a defective compressor.
2. Properly unpack and prepare a compressor for installation.
3. Demonstrate the ability to successfully solder or braze the proper refrigerant lines to the compressor.
4. Properly connect electrical wires to the compressor as necessary.
5. Run the compressor to insure proper installation.
6. List the problems associated with capillary tubes.
7. Describe the procedures for correcting capillary tube problems.
8. List the steps required to:
 - a) remove a defective evaporator
 - b) prepare an evaporator for installation
 - c) test the system to insure proper installation
9. List the steps required to:
 - a) repair a defective evaporator
 - b) prepare an aluminum evaporator for repair
 - c) test the system to insure proper repair

10. List the steps required to:
 - a) remove a defective condenser
 - b) prepare for a condenser installation
 - c) test the system to insure proper installation
11. List the steps required to:
 - a) repair a defective condenser
 - b) prepare a steel condenser for repair
 - c) test the system to insure proper repair
12. List the steps required to:
 - a) remove a defective filter/drier
 - b) prepare a new filter/drier installation
 - c) test the system to insure proper installation

C. System Evacuation and Charging 4 Hours

Outcome: ***Demonstrate cleaning, evacuating and charging of sealed systems.***

1. Describe and demonstrate the use of vacuum pumps.
2. Demonstrate the ability to maintain vacuum pumps.
3. Describe and demonstrate the ability to back flush a sealed system.
4. Describe and demonstrate the ability to sweep charge a sealed system.
5. List the safety precautions to follow when adding refrigerants to systems.
6. Describe and demonstrate the ability to add the correct type and amount of refrigerant to a system.
7. Describe the procedures for testing metering devices.

D. Air Conditioners..... 6 Hours

Outcome: ***Demonstrate the ability to diagnose and repair air conditioning systems.***

1. List the operating principles of window air conditioners.
2. List the operating principles of split system air conditioners as installed in existing furnace systems.
3. Describe and demonstrate procedures for troubleshooting and cleaning air conditioners.
4. Disassemble and reassemble a window air conditioner.
5. List the steps required to test a window and split system air conditioner.
6. Read and interpret several different air conditioning wiring diagrams.
7. Draw a wiring diagram for both a window air conditioner and a split system.
8. Size and select air conditioning equipment for window air conditioning applications.
9. Describe the general installation procedures for air conditioners.

E. Filters 2 Hours

Outcome: ***Describe types of air filtering systems.***

1. List the reasons for filtering air.
2. List the problems created by dirty air filters.
3. Describe the construction and replacement of throw away air filters.

4. Describe the construction, and cleaning of washable air filters.
5. Describe the safety precautions to be observed when inspecting or cleaning electronic air filters.
6. Describe the construction, removal and replacement of electronic air filters.

F. Workplace Coaching Skills and Advisory Network4 Hours

Outcome: ***Demonstrate the knowledge of coaching skills required to train an apprentice.***

1. Describe the following coaching skills used for training apprentices:
 - a) identify the point of the lesson
 - b) link the lesson
 - c) demonstrate a skill
 - d) provide opportunity to practice a skill
 - e) give feedback to learner
 - f) assess the learner's progress
2. Describe the role and purpose of the advisory network and the Provincial Apprenticeship Committee for the Appliance Service Technician trade.



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